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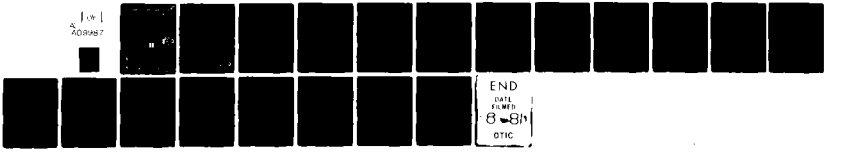

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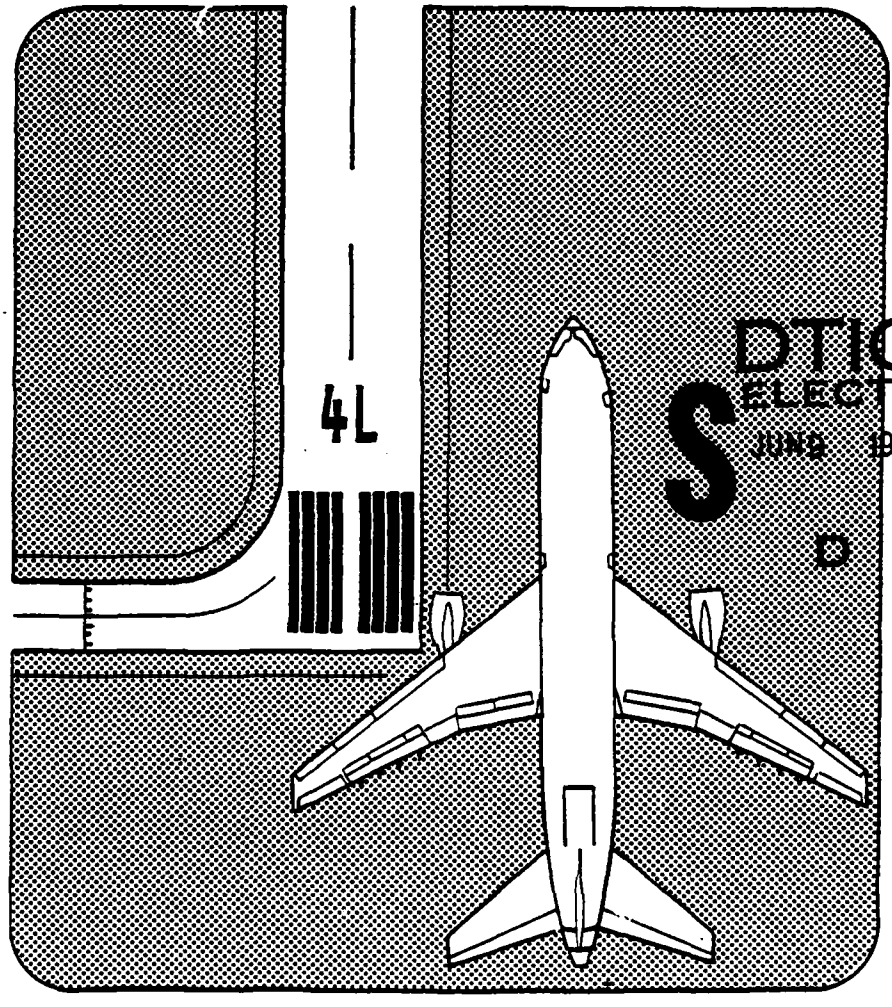
LEVEL III
NEW YORK AIRPORTS

DATA PACKAGE NO. 8

JOHN F. KENNEDY INTERNATIONAL AIRPORT,
LA GUARDIA AIRPORT.

AIRPORT IMPROVEMENT
TASK FORCE DELAY STUDIES



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PMM&Co. Peat, Marwick, Mitchell & Co.

DECEMBER 1979

PEAT, MARWICK, MITCHELL & Co.

P. O. BOX 8007

SAN FRANCISCO INTERNATIONAL AIRPORT

SAN FRANCISCO, CALIFORNIA 94128

Telephone: (415) 347-9521

January 2, 1980

Mr. Michael M. Scott, ATF-4
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

Re: New York Data Package No. 8, December 1979

Dear Mike:

Attached is New York Data Package No. 8. The material in this Data Package is a summary of the results of the various delay investigations undertaken by the New York Task Force. This summary is intended for use by the Task Force in their preparation of a final report.

This information should be reviewed by members of the New York Task Force at their January 23, 1980, meeting.

Sincerely,

Steve

Stephen L. M. Hockaday
Manager

SLMH/jc
Enclosure

cc: Mr. J. R. Dupree (ALG-312)
Mr. L. Achitoff (AEA-4)

Data Package No. 8

SUMMARY OF DELAY RESULTS

New York

Airport Improvement Task Force Delay Studies

LaGuardia Airport

and

John F. Kennedy International Airport

Prepared by

Peat, Marwick, Mitchell & Co.
San Francisco, California

December 1979

New York Task Force Delay Studies

SUMMARY OF DELAY RESULTS

This document is a summary of the major delay analysis results of the New York Task Force. The results are organized according to the major improvements and issues investigated in the New York Task Force Delay Studies. In addition, general trends in delays by 1982 and 1987 are presented.

Purpose

The purpose of this document is to provide a narrative summary of results that can be used by the New York Task Force in preparing their final report.

Scope

The results for the major improvements and issues found to affect delay by the Task Force for both LaGuardia Airport and John F. Kennedy International Airport are included in this summary. The results of the LaGuardia west-taxiway delay investigation are not included but will be made available at the next Task Force meeting.

DELAY RESULTS FOR LAGUARDIA AIRPORT

The Airfield Simulation Model was used to estimate peak-hour delay trends, delays associated with individual improvements, and the effects of the sensitivity analyses. The Annual Delay Model was used to estimate annual delays and annual savings in terms of hours of delays, operating cost, and fuel consumption.

The Airfield Simulation Model was run for the time period 1500 to 2100 hours. Statistics on average delays were obtained for both the entire simulation period and the peak demand hour.

Baseline Delays (1, 3)

Baseline delays were estimated for the 1978 LGA airfield, ATC system, and demand level for frequently occurring weather conditions and runway uses. The delay results for the most frequent runway use, arrivals on Runway 22 and departures on Runway 13, are tabulated below:

Average Baseline Delays - Minutes

Arrivals		Departures	
VFR1*	IFR2**	VFR1*	IFR2**
12.8	50.8	1.5	24.1

*VFR1 conditions are ceiling at least 2,000 feet and visibility at least 3 miles.
**IFR2 conditions are ceiling less than 600 feet and visibility less than 1 mile.

The foregoing delay values are averages over the peak 6-hour period, 1500-2100 hours, at LGA.

Future Delays With Future ATC Systems (31, 36, 37, 41)

The benefits achievable with projected improvements to the air traffic control (ATC) system and the timing of those improvements are uncertain. For the New York Task Force Delay Studies, the improvements as described in FAA Report FAA-EM-78-8A, Parameters of Future ATC Systems Relating to Airport Capacity/Delay, were assumed. In particular, the "near-term" improvements of that report were assumed to apply in 1982 and the "far-term" improvements were assumed to apply in 1987. There is considerable doubt, however, that this implementation schedule is feasible.

The expected effects of the ATC improvements were estimated for frequently occurring weather conditions and runway uses. Results for the case of arrivals on Runway 22 and departures on Runway 13 are tabulated below:

	Average Delays--Minutes			
	Arrivals		Departures	
Year	VFR1	IFR2	VFR1	IFR2
1978	12.8	50.8	1.5	24.1
1982	2.2	9.4	1.4	8.0
1987	2.4	9.9	1.4	16.7

The foregoing delays reflect both the projected demand forecasts for 1982 and 1987 and the airfield and ATC improvements assumed for those two years. As shown, delays are expected to reduce significantly between 1978 and 1982 but then increase slightly by 1987. For example, estimated average arrival delays in minimum IFR conditions are 50.8 minutes, 9.4 minutes, and 9.9 minutes for 1978, 1982, and 1987, respectively.

Future Delays With the 1978 ATC System (52, 53, 32, 38)

The foregoing delay estimates produced by the Task Force for the baseline conditions assumed that there would be significant reductions in aircraft separations in 1982 and even greater reductions by 1987. The exact timing of these separation reductions and improvements to the ATC system is uncertain, however, so the Task Force decided to estimate what would happen if the 1978 ATC system and separations were assumed for 1982 and 1987. The effects of this assumption were estimated for the case of the most frequent runway use at LaGuardia (arrivals on Runway 22 and departures on Runway 13) in IFR1 conditions, and the results are summarized in the following table:

	IFR1 Average Delays - Minutes			
	1982		1987	
ATC System	Arrivals	Departures	Arrivals	Departures
Future (78-8A)	16.4	1.1	5.2	1.2
1978	17.6	1.0	17.9	1.2

Thus, arrival delays estimated for 1987 are very sensitive to the assumed ATC system. The differences in departure delays are insignificant, and the slight increase in average departure delay associated with future separations is due to the fact that more arrivals get in, and thus the effective departure demand is slightly greater.

Relocation of Runway 13 Glide-Slope Antenna (10, 7)

At present, the location of the glide-slope antenna on Runway 13 is such that, during mixed operations on that runway, there must be approximately 7 miles between arrivals for a departure to be released. The elimination of this extra separation requirement results in savings of approximately 25 minutes of average arrival delay and 3 minutes of average departure delay in the peak hour in IFR1* weather conditions.

Interaction Between LaGuardia and Teterboro Arrivals (10A,7)

Airspace interactions between the arrivals to Teterboro Airport and arrivals to LaGuardia Airport involve a one-for-one tradeoff when an interaction occurs. Therefore, during busy arrival periods at Teterboro Airport, minimum separations between arrivals to LaGuardia Airport must be approximately 15 nautical miles. If this interaction occurs for several

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*IFR1 weather conditions exist when the ceiling is at least 600 feet and visibility is at least 1 mile.

hours under IFR1 weather conditions, average delays to arrivals become as large as 109 minutes. With no interaction between LaGuardia and Teterboro arrivals, the corresponding average IFR1 delays are approximately 54 minutes, or less than half the interaction case.

Airspace Improvements to Permit Arrivals on Runway 13 and Departures on Runway 4 (9, 7)

In IFR1 weather at present, arrivals to Runway 13 are not independent of the departures on Runway 4 because of airspace interactions. If these two streams were independent, the delay savings (compared to the case where both arrivals and departures are on Runway 13 in IFR1 weather) are approximately 18 minutes of average arrival delay and about 8 minutes of average departure delay.

Enforcement of FAR Part 93 Quota Mix (19, 20, 1, 11)

According to FAR Part 93, Subpart K, "High Density Traffic Airports," IFR operations per hour at LaGuardia Airport are limited to 48 air carriers, 6 scheduled air taxis, and 6 "others" (general aviation). In addition, there is a provision for air taxis to take slots not used by air carriers and also for "other" aircraft to take slots not used by scheduled air taxis or air carriers.

Enforcement of the foregoing quota restrictions in IFR2 and VFR1 conditions results in a reduction in average arrival delay and average departure delay, as shown in the table below:

	Average Delays--Minutes			
	Arrivals		Departures	
	VFR1	IFR2	VFR1	IFR2
With FAR Part 93 enforcement	4.1	13.4	1.2	11.1
Without enforcement	12.8	25.6	1.5	18.2

Implementatation of ASDE (11, 3)

When operating with arrivals on Runway 22 and departures on Runway 13 in IFR2 weather, a departure on 13 cannot be released until ATC is assured that the arrival on 22 is beyond the intersection. This generally means that the arrival must reach Taxiway E on Runway 22 before it can be seen.

Implementation of ASDE would enable the Tower controllers to know when an arriving aircraft clears the runway intersection, thus causing a reduction in arrival-departure separations. It is estimated that this would save about 16 minutes of average arrival delay and 20 minutes of average departure delay in the peak hour.

Sensitivity Test of Port Authority Forecasts (48, 49, 32, 38)

The Port Authority of New York and New Jersey (PNYNJ) forecasts for 1982 and 1987 for LaGuardia Airport show greater percentages of heavy aircraft in the mix than the corresponding Task Force forecasts. For example, the 1982 Port Authority forecast shows 9.5% heavies and 336 operations in the 6-hour simulation period, while the Task Force forecast shows only 3.7% heavies and 355 operations.

Similarly, the 1987 Port Authority forecast shows 32.9% heavy aircraft and 316 operations in the 6-hour simulation, while the Task Force forecast shows 6% heavy aircraft and 367 operations in the 6-hour period.

For the 1982 forecasts, the delays associated with the Port Authority forecast were approximately the same as the delays associated with the Task Force forecast. For 1987, however, the Port Authority forecasts resulted in lower delays to both arrivals and departures compared with the Task Force forecast as shown in the following table:

	1987 IFR1 Average Delays-Minutes	
Forecast	Arrivals	Departures
Task Force	3.0	1.5
PNYNJ	1.1	1.1

Sensitivity Tests of the 1978 GA Level and 1978 ATC System (50, 51, 54, 55, 32, 38)

The 1982 and 1987 forecasts adopted by the Task Force show a sharp reduction in general aviation (GA) operations when compared with 1978 air traffic counts. For example, the Task Force forecast for 1982 contains about 75 total GA operations in the 6-hour simulation period compared with over 120 actual GA operations in the same period in 1978. Therefore, the Task Force decided to estimate the delays that would occur if the 1978 GA operations level was sustained in 1982 and 1987.

One set of sensitivity tests was conducted using future ATC separations. The effects of assuming that both the 1978 GA level and the 1978 ATC system apply in 1982 and 1987 were also investigated by the Task Force. The differences in 1982 were small. In 1987, however, the combined effect of assuming that both the 1978 GA level and ATC system apply was greater than either of the individual effects as shown in the table below:

GA Traffic/ ATC System Combination	IFR1 Average Delays - Minutes			
	1982		1987	
	Arrivals	Departures	Arrivals	Departures
Task Force GA/ Future ATC	16.4	1.1	5.2	1.2
1978 GA/ Future ATC	20.8	1.1	7.7	1.2
Task Force GA/ 1978 ATC	17.6	1.0	17.9	1.2
1978 GA/ 1978 ATC	27.6	1.2	29.8	1.1

Annual Delay Results (39, 40, 40A, 41, 42, 43, 44, 44A, 44B, 44C, 45, 45A, 46, 47)

The LGA airfield improvements assumed in applying the Annual Delay Model for estimating future annual delays included ASDE, Runway 13 glide-slope antenna, and a high speed exit on Runway 13. In addition, the 1978 level of GA operations was assumed for the 1982 and 1987 annual delay investigations.

The results of these investigations are summarized in the table below:

Improvement Items(s)	Average Annual Delays - Minutes		
	1978	1982	1987
Do Nothing	18.0	19.4	22.6
Airfield Only	--	18.5	19.1
ATC Only	--	16.6	14.8/18.5[a]
Both Airfield and ATC	--	15.8	11.0/17.3[a]

a. X/Y represents 1987 delay estimates associated with far-term/intermediate-term separations.

Compared to the "do-nothing" case, the LGA improvements can lead to annual savings in aircraft operating costs of $86 million ($39 million for the intermediate-term ATC) assuming an aircraft unit operating cost of $20 per minute.

RESULTS FOR JOHN F. KENNEDY INTERNATIONAL AIRPORT

For John F. Kennedy International Airport (JFK), the Airfield Simulation Model was used to estimate the effects of a number of different airfield and ATC improvements, and also to estimate the trends in delays for the years 1982 and 1987. In addition, the Annual Delay Model was used to estimate the annual delays for 1982 and 1987 under different combinations of air traffic control and airfield improvements.

Baseline Delays (1, 2)

Baseline delays were estimated for the 1978 JFK airfield, ATC system, and demand level for frequently occurring weather conditions and runway uses. The delay results for the most frequent runway use, arrivals, and departures on Runways 22L and 22R are tabulated below:

Average Baseline Delays - Minutes

Arrivals		Departures	
VFR1*	IFR1**	VFR1*	IFR1**
0.8	83.0	5.5	3.1

*Ceiling at least 2,000 feet and visibility at least 3 miles.
**Ceiling at least 600 feet and visibility at least 1 mile.

The foregoing delay values are averages over the peak 8-hour simulation period, 1500-2100 hours, at JFK.

Future Delays With Future ATC Systems (26, 30, 35, 39)
As in the case of LGA, the separations and the parameters of FAA Report FAA-EM-78-8A were assumed to apply in the JFK delay analyses. Near-term improvements were assumed for 1982 and far-term improvements were assumed for 1987.

The expected effects of the foregoing ATC improvements were estimated for a variety of weather conditions and runway uses. Results for the case of aircraft operations on Runways 22L and 22R are tabulated below:

	Average Delays - Minutes			
	Arrivals		Departures	
	VFRI	IFRI	VFRI	IFRI
1978	0.7	83.0	11.6	3.1
1982	1.0	95.1	26.8	5.9
1987	0.7	32.5	7.9	4.4

Note that if the future ATC system improvements were implemented, delays would increase significantly by 1982 and then decrease to below 1978 levels by 1987. These delay estimates reflect the demand forecasts and airfield improvements for 1982 and 1987 in addition to the ATC improvements.

Future Delays With the 1978 ATC System (44, 45, 26, 35)
The foregoing delay estimates were based on the assumption that near-term air traffic control separations were in effect by 1982 and that far-term air traffic control separations applied in 1987. Because it is uncertain exactly when these

separation improvements will be implemented, the Task Force investigated the effects on delay of assuming that the 1978 air traffic control system is still in effect in 1982 and 1987. The tests were conducted using the most frequent IFR1 runway use at JFK, arrivals on 22L and departures on 22R.

The results showed greater arrival delays with 1978 ATC separations than with the assumed 1982 and 1987 separations, especially in 1987, as shown in the table below:

	IFR1 Average Delays - Minutes			
	1982		1987	
ATC System	Arrivals	Departures	Arrivals	Departures
Future (78-8A)	95.1	31.7	32.5	4.4
1978	122.0	29.6	131.9	5.2

The high separation sensitivity in 1987 is due to the very high percentage of heavy aircraft (71.6%) in the 1987 Task Force forecast and the fact that the 1987 separations assume greatly reduced wake-turbulence effects compared to 1978 separations.

Thus, the delay estimates for 1982 and 1987 are very sensitive to assumptions about the implementation of future ATC improvements, especially in IFR1 conditions.

New Exit on Runway 22L (19, 2A, 1)

The New York Task Force investigated the effect of providing a new exit taxiway on Runway 22L at JFK, between exits H and J, for use in the case where exit taxiway J is closed and aircraft that miss exit H must go to the end of the runway.

The delay effects of this new exit were estimated for IFR1 conditions using the 1978 demand level and air traffic control system. The new exit would save about 1.5 minutes of average arrival delay during the peak demand period under the conditions specified. The effects of this improvement would be even greater if future separations were reduced because the expected reductions in arrival-arrival separations would make runway occupancy times a more critical determinant of arrival capacity and delay.

Staggered Arrivals on Runways 4R and 4L (18, 4)

When operating on Runways 4R and 4L in IFR1 conditions, the usual procedure is to have arrivals on 4R and departures on 4L. The Task Force investigated the effects of using staggered arrivals to these two parallel runways with 2-nautical-mile separations. The result shows substantial

savings in arrival delays compared to the single-arrival-runway case as shown in the following table:

Arrival Runways	Average Arrival: Hourly Flow Rates	Delays - Minutes
4R only	24	91.2
Staggered Approaches to 4R and 4L	35	32.4

Independent Departures on Runways 31L and 31R (16, 5)

At present, operations on Runways 31L and 31R in VFR1 conditions usually involve arrivals on 31L and 31R and departures on just 31L because of airspace constraints. The Task Force investigated the effects of using 31R for short-range departures.

Substantial savings in average peak hour departure delays would result from this improvement. For example, with a single departure runway, average departure delays were approximately 10.1 minutes compared to only 2 minutes with two departure runways.

Independent Operations on 31R and 31L in IFR1 Conditions (15, 6)

In IFR1 conditions, arrivals now use 31R and departures use 31L. The Task Force explored the effects of having independent operations on these two runways, i.e., independent arrivals, departures, and missed approaches.

Higher flow rates and significant delay savings would result from this improvement as shown in the table below:

Runway Use	Average Hourly Flow Rates		Average Runway Delays - Minutes	
	Arrivals	Departures	Arrivals	Departures
Arrivals-31R Departures - 31L	27	39	82.9	3.1
Independent operations on 31L and 31R	33	45	2.8	2.8

Annual Delay Results (34, 35, 35A, 36, 37, 38, 39, 39A, 39B, 39C, 40, 40A, 41, 42)

The JFK airfield improvements assumed for estimating future annual delays included new exits on Runways 4R, 22L, and 31L; simultaneous independent operations on Runways 31L and 31R in VFR1 and IFR1 weather; 2-nautical-mile staggered approaches to Runways 4R and 4L; and an improved ASDE. The results of the annual delay analyses are summarized in the table below according to combinations of the assumed improvements:

Improvement Items	Average Annual Delays - Minutes		
	1978	1982	1987
Do nothing	15.0	31.3	37.3
Airfield only	--	23.0	23.1
ATC only	--	21.6	13.8/20.2[a]
Both airfield and ATC	--	17.4	7.5/10.9[a]

a. 1987 delay estimates associated with far-term/intermediate-term separations.

Compared to the "do-nothing" case, the airfield improvements and far-term ATC improvements lead to annual savings of $247 million in aircraft operating costs ($219 million for the intermediate-term ATC case), assuming an aircraft unit operating cost of $20 per minute.


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